Section 3:

Landfill Gas Characterization (Constituents/Concentrations)

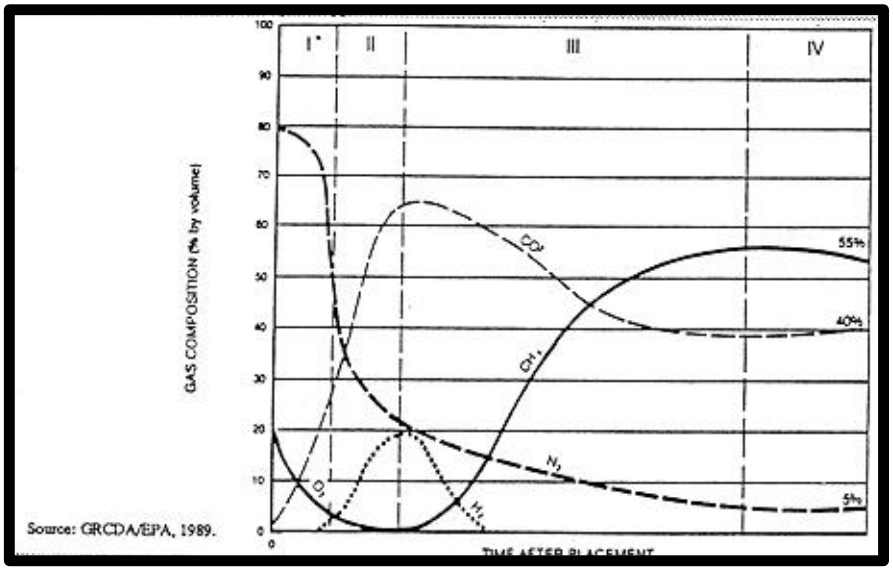
When wastes are placed into a Class I landfill, there is a mixture of biodegradable materials, moisture and air (in the void spaces). In this environment, decomposition of the waste (i.e., "rotting"), and gas generation is inevitable. Initially, the dominant bacteria in the wastes are those which use the oxygen from the void spaces as an ingredient during the waste decomposition process (this is called Aerobic decomposition). The primary gaseous product of Aerobic decomposition is carbon dioxide. Once the oxygen contained in the void spaces in the waste has been consumed during the Aerobic decomposition process, another type of bacteria becomes dominant, and a decomposition process begins which does not require the presence of oxygen (this is called Anaerobic decomposition). During Anaerobic decomposition, the primary gaseous products of decomposition are methane (~55%) and Carbon Dioxide (~45%), but other constituents are present in trace amounts (see Table 1 below).

TABLE 1: Landfill Gas Composition

Component	Percent Volume (Dry Weight Basis, Excluding Moisture Content)
Methane (CH_4)	45% to 58%
Carbon Dioxide (CO_2)	32% to 45%
Nitrogen (N_2)	0% to 3%
Hydrogen (H_2)	Trace to less than 1%
Carbon Monoxide (CO)	Trace (an indicator of possible subsurface fire)
Hydrogen Sulfide (H_2S) and other sulfur compounds	Varies (Normally 10-200ppm)
Moisture	Up to 14% (increases with gas temperature).
Volatile Organic Compounds (VOCs)	Typically .25% to .50%

Landfill gas is flammable (or explosive), has a vapor density approximately equal to that of air, has a typical temperature range of 60 to 125 degrees Fahrenheit in a landfill environment, has a moisture content such that the formation of condensate almost always occurs upon cooling, and may contain trace gases capable of nuisance odors, etc. It should be noted that methane generation will cease as the anaerobic decomposition of wastes reaches completion. The flammable range of methane is 5 to 15 percent (by volume) in air, and the autoignition temperature of methane is 1004 degrees Fahrenheit. Landfill gas my be either lighter than air or heavier than air, and its behavior will be determined by its overall composition. The characteristic odor of landfill gas is due to the presence of trace compounds, including esters, phenols, organic acids, solvents, and sulfur compounds (including mercaptans). It should be noted, however, that landfill gas may have not identifiable odor because of the filtering out of the trace gas components by soils or cover materials during migration. **(See Note 3).** Methane alone is both odorless and colorless.

Figure 1: Changes in Landfill Gas Composition Over Time



Source: EPA Document EPA/600/K-92/002
"Seminars - Design, Operation and Closure of Municipal Solid Waste Landfills"

Note 3: A brief description of the mechanisms of landfill gas migration is included in Section 4 of this document.